

DESCRIPTION OF THE IMMATURE STAGES AND ADULT MALE OF
NEOLECANIUM CORNUPARVUM (HOMOPTERA: COCCIDAE)¹

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Abstract.—The three immature instars of the female and five instars of the male of *Neolecanium cornuparvum* (Thro) are described and illustrated. A key for separation of all developmental stages of the species is included. The male of *N. cornuparvum*, *Pseudophilippia quaintancii* Cockerell and *Toumeyella parvicornis* (Cockerell) are placed in a newly proposed major Coccidae group, the *Toumeyella* group.

The magnolia scale, *Neolecanium cornuparvum* (Thro, 1903), is a soft scale which commonly infests magnolias in eastern United States. It has been recorded from the states of Alabama, Connecticut, Florida, Georgia, Indiana, Kentucky, Louisiana, Maine, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Virginia, West Virginia, and Wisconsin. All specimens from Alabama, Louisiana, and South Carolina seen by us that were identified as magnolia scale, actually were tuliptree scale, *Toumeyella liriodendri* (Gmelin), and therefore were misidentified. This information leaves doubt about the occurrence of the magnolia scale in these three states.

A heavy infestation of the magnolia scale may cause death of its host, but most often damaging populations are localized, resulting in dieback on a portion of the plant. *Neolecanium cornuparvum* has been recorded from *Magnolia acuminata*, *M. cordata*, *M. grandiflora*, *M. liliflora*, *M. soulangiana*, and *M. stellata*.

Although the magnolia scale was originally described as a species in the genus *Lecanium*. It was later placed in *Neolecanium* by Fernald (1903). It shares many characteristics with members of the genus *Toumeyella*. Steinweden (1929) regarded *Neolecanium*, *Pseudophilippia* and *Toumeyella* as representing a single genus, but stated that a complete understanding of this group could only be achieved with an examination of a wider range of forms than he studied. Until thorough investigations of the genera *Neolecanium* and *Toumeyella* are completed, we will attempt no further clarification of placement of *N. cornuparvum*.

Previous taxonomic studies of Coccidae have dealt primarily with the adult female, with little attention to other developmental stages. In this paper all developmental stages of *N. cornuparvum* are described and illustrated. The adult female

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was described in detail by Williams and Kosztarab (1972). Our interpretation of the fringe setae and hypopygial setae of the adult female differs from theirs and is as follows: anal fold with one pair of fringe setae and 16 to 20 hypopygial setae. Terminology in the descriptions of the prepupa, pupa, and adult male is taken mainly from Giliomee (1967), while that for the adult female and immature stages is from Williams and Kosztarab (1972).

This study is based on material from the National Museum of Natural History Coccoidea Collection, Beltsville, Maryland (USNM) and the Auburn University Coccoidea Collection (AU). In addition to the material listed below, we have examined a single specimen on a slide (USNM) labeled *Lecanium cornuparvum*, Type, Cornell U., lot 276, sub. 16, no. 162. Collection data presented under material studied include number of slides and their depository in parentheses followed by host and locality records. Measurements (based on 10 specimens) are given in microns and presented as the average followed by the range in parentheses.

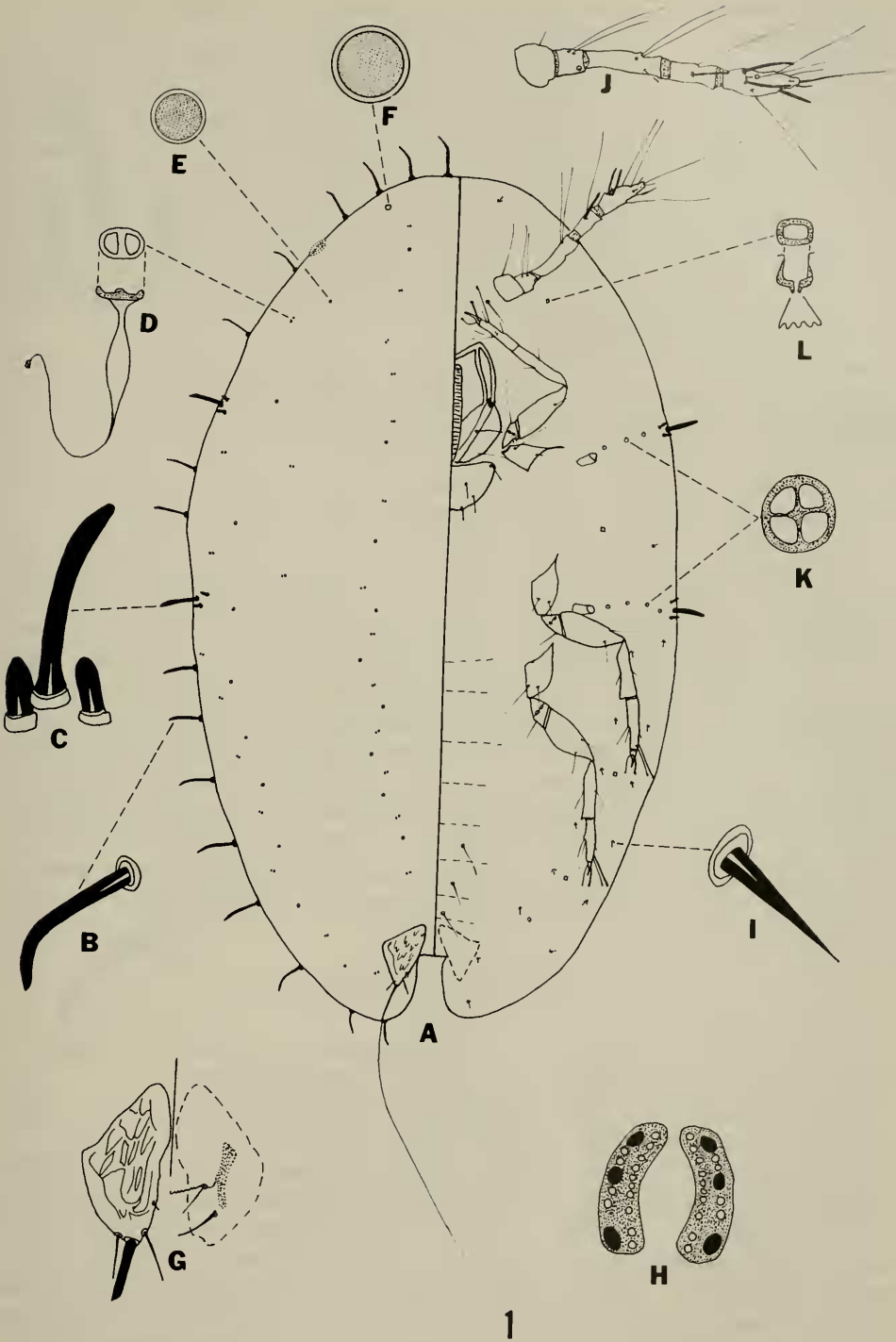
KEY TO STAGES OF *NEOLECANIUM CORNUPARVUM*

- | | |
|--|----------------------|
| 1. Anal plates present | 2 |
| – Anal plates absent | 6 |
| 2. Anal plates with 1 pair of apical setae longer than length of anal plates; legs and antennae well developed | first instar |
| – Anal plates with apical setae less than length of anal plates; legs and antennae greatly reduced | 3 |
| 3. Anal ring with 6 anal ring hairs; 1 pair of hypopygial setae (which resemble fringe setae) | 4 |
| – Anal ring with 8 or 10 anal ring hairs; 2 or more pairs of hypopygial setae (distinct from fringe setae) | 5 |
| 4. Tubular ducts present on margin around cephalic $\frac{3}{4}$ of body; body elongate oval | second-instar male |
| – Tubular ducts absent; body oval to nearly circular | second-instar female |
| 5. Anal ring with 10 anal ring hairs; large discoidal pores present anterior to anal plates; ventral tubular ducts present | adult female |
| – Anal ring with 8 anal ring hairs; large discoidal pores absent anterior to anal plates; ventral tubular ducts absent | third-instar female |
| 6. Wings present; legs and antennae distinctly segmented, 2 pairs of eyes and 1 pair of lateral ocelli present; derm with heavily sclerotized areas on head and thorax | adult male |
| – Wing buds present; legs and antennae without distinct segments; eyes absent; derm almost entirely membranous | 7 |
| 7. Legs less than $\frac{1}{4}$ length of body; penial sheath short, rounded | prepupal male |
| – Legs greater than $\frac{1}{3}$ length of body; penial sheath elongate, triangular ... | pupal male |

FIRST INSTAR

Fig. 1

Material studied.—73 (AU), 9 (USNM): *Magnolia acuminata*, Great Belt, Pa. *Magnolia soulangeana*, Allegany Co., Md. *Magnolia* sp., Oakland, Md.; Angelica, N.Y.; Buffalo, N.Y.; Rochester, N.Y.; New York; Cleveland, Ohio; North Bloomington, Ohio; Bethlehem, Pa.; Philipsburg, Pa; Pittsburgh, Pa; Fairmont, W. Va.



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Fig. 1. *Neolecanium cornuparvum*, first instar.

General appearance.—Body (Fig. 1A) flat, elongate oval, membranous. Slide-mounted specimens 520–854 long, 303–482 wide.

Dorsal surface.—Derm membranous. Marginal setae (Fig. 1B) 36 (31–43) long on head tapering to 19 (15–22) long near anal cleft; bristle-like, often bent posteriorly; distributed as follows: 12 between anterior spiracular setae, 2 on each side of body between anterior and posterior spiracular setae, 16 on posterior of body. No body setae detected. Three spiracular setae (Fig. 1C) in each spiracular furrow; median seta 30 (22–34) long, thick, throughout length; lateral setae 10 (9–12) long. Submarginal tubercles absent. Bilocular pores (Fig. 1D) in 4 to 6 longitudinal rows. Simple disc pores (Fig. 1E) in similar pattern on abdomen. Apex of head with 2 large disc pores (Fig. 1F). No ducts detected. Eyes on margin just above level of antennal scape.

Anal plates (Fig. 1G).—Each plate triangular with rounded angles; dorsal surface reticulate; 64 (56–68) long, 33 (31–40) wide; cephalolateral margin 43 (40–46) long, caudolateral margin 42 (37–46) long. Each plate with 4 apical setae, 3 on apex of plate, 1 on median margin; median seta on apex 274 (111–414) long. Each plate with 1 subapical seta. Anal fold with 1 pair of fringe setae. Anal ring (Fig. 1H) quadrate with convex lateral margins, 6 hairs and 2 rows of pores.

Ventral surface.—Ventral submarginal setae (Fig. 1I) short, bristle-like, in a row of 7 setae on each side of abdomen, 1 between spiracular furrows on each side of body, and 1 pair at apex of head; short, bristle-like. Body setae similar to submarginals, in a submedian row on each side of abdomen. One pair interantennal setae. Three pairs of large, posterior, submedian setae, posterior pair longest. Antenna (Fig. 1J) well developed, 5-segmented, 168 (152–176) long. Legs well developed, 261 (244–275) long, without tibiotarsal sclerotization or free articulation; claws without denticle; 2 knobbed claw digitules; 2 slender knobbed tarsal digitules, except prothoracic tarsi with 1 digitule setiform. Spiracular furrows with quadralocular pores (Fig. 1K); each anterior pore band with 3 pores; each posterior pore band with 4 pores. Quinquelocular or multilocular pores occasionally in spiracular furrows. Microducts (Fig. 1L) between submarginal and body setae on abdomen, 1 between spiracular furrows on each side of body, and 1 lateral to each antennal scape. Tubular ducts not detected.

SECOND-INSTAR FEMALE

Fig. 2

Material studied.—8 (AU), 1 (USNM); *Magnolia acuminata*, Cave Forge, Pa; Centre Co., Pa. *Magnolia* sp., Beaver Falls, Pa.; Pittsburgh, Pa.

General appearance.—Body (Fig. 2A) oval to nearly circular. Slide-mounted specimens 1454–1795 long, 928–1528 wide.

Dorsal surface.—Derm membranous. Marginal setae (Fig. 2B) 18 (12–31) long, pointed, often bent posteriorly, 12 to 16 around head, not easily separated from ventral submarginal setae. No body setae detected. Three spiracular setae (Fig. 2C) in each spiracular furrow; median seta 28 (19–56) long, thick, with pointed apex; lateral setae 25 (19–31) long with rounded to acute apices. Submarginal tubercles absent. Bilocular pores (Fig. 2D) with inner filament and simple disc pores (Fig. 2E) scattered over dorsum. No ducts detected. Eyes submarginal just above level of antennal scape.

Anal plates (Figs. 2F1, 2F2).—Each plate triangular with posterior angles broadly

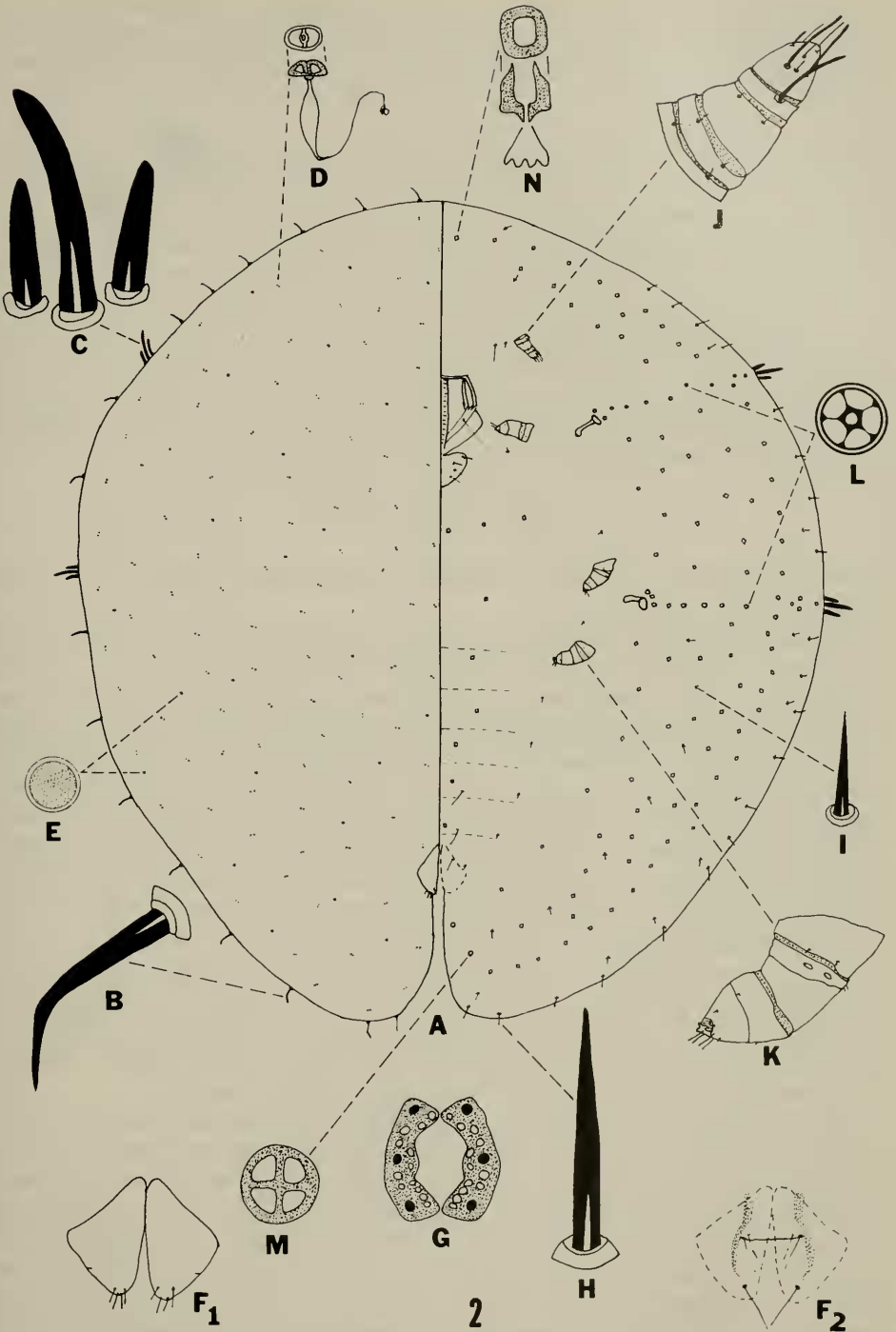


Fig. 2. *Neolecanium cornuparvum*, second-instar female.

rounded; 97 (93–105) long, 70 (62–93) wide; cephalolateral margin 76 (74–80) long, caudolateral margin 71 (62–74) long. Each plate with 4 apical setae and 1 subapical seta. Anal fold with 1 pair of fringe setae and 1 pair of hypopygial setae. Anal ring (Fig. 3G) quadrate, lateral margins convex, with 6 hairs and 2 rows of pores.

Ventral surface.—Ventral submarginal setae (Fig. 2H) bristle-like. Body setae (Fig. 2I) scattered over venter and 1 near each coxa; 2 pairs of bristle-like interantennal setae, median pair longer. Three pairs of posterior submedian setae. Antenna (Fig. 2J) greatly reduced, 5-segmented, 56 (50–74) long. Legs (Fig. 2K) greatly reduced, 72 (43–99) long, without tibiotarsal sclerotization or free articulation; tarsal and claw digitules bristle-like. Spiracular furrows with pore bands 1 or 2 pores wide; each anterior pore band with 7 to 13 pores; each posterior pore band with 11 to 17 pores. Quinquelocular pores (Fig. 2L) in spiracular furrows. Multilocular pores occasionally in spiracular furrows. Usually 3 or 4 quadralocular pores (Fig. 2M) in anal area. Microducts (Fig. 2N) scattered over venter and in submarginal row around body. Tubular ducts not detected.

THIRD-INSTAR FEMALE

Fig. 3

Material studied.—12 (AU), 2 (USNM): *Magnolia* sp., Western Port, Md.; Pittsburgh, Pa.

General appearance.—Body (Fig. 3A) oval to nearly circular. Slide-mounted specimens 1516–2376 long, 1170–2104 wide.

Dorsal surface.—Derm membranous. Marginal setae (Fig. 3B) 19 (15–22) long on head to 25 (20–31) long near anal cleft, pointed, bristle-like, not easily separated from ventral submarginal setae. Dorsal body setae (Fig. 3C) 6 (4–7) long, coniform, scattered over dorsum. Three spiracular setae (Fig. 3D) in each spiracular furrow; median seta 40 (28–52) long, tapering to acute or acutely rounded apex; lateral setae 32 (22–48) long, subconical. Submarginal tubercles absent. Bilocular pores with inner filament (Fig. 3E) and simple disc pores (Fig. 3F) scattered over dorsum. No ducts detected. Eyes submarginal just above level of antennal scape.

Anal plates (Figs. 3G1, 3G2).—Each plate triangular with rounded angles; 150 (117–173) long, 104 (82–114) wide; cephalolateral margins slightly concave, caudolateral margins slightly convex; cephalolateral margin 130 (117–153) long, caudolateral margin 110 (95–127) long. Each plate with 4 apical setae and 3 or 4 subapical setae. Anal fold with 1 pair of fringe setae and 4 to 6 hypopygial setae. Anal ring (Fig. 3H) rounded, with 8 hairs and 2 rows of pores.

Ventral surface.—Ventral submarginal setae (Fig. 3I) similar to marginal setae. Body setae (Fig. 3J) scattered over body and 1 or 2 near each coxa; 2 pairs of interantennal setae, median pair longer. Three pairs of posterior, submedian setae. Antenna (Fig. 3K) greatly reduced, 5- or 6-segmented, 81 (77–86) long. Legs (Fig. 3L) greatly reduced, 104 (88–126) long, without tibiotarsal sclerotization or free articulation; tarsal and claw digitules bristle-like. Spiracular furrows with pore bands 1 to 7 pores wide; each anterior band with 25 to 42 pores; each posterior band with 31 to 49 pores. Quinquelocular pores (Fig. 3M) in spiracular furrows and in anal region. Trilocular, quadralocular, and multilocular pores occasionally in spiracular furrows or anal area. Microducts (Fig. 3N) scattered over venter. Tubular ducts not detected.

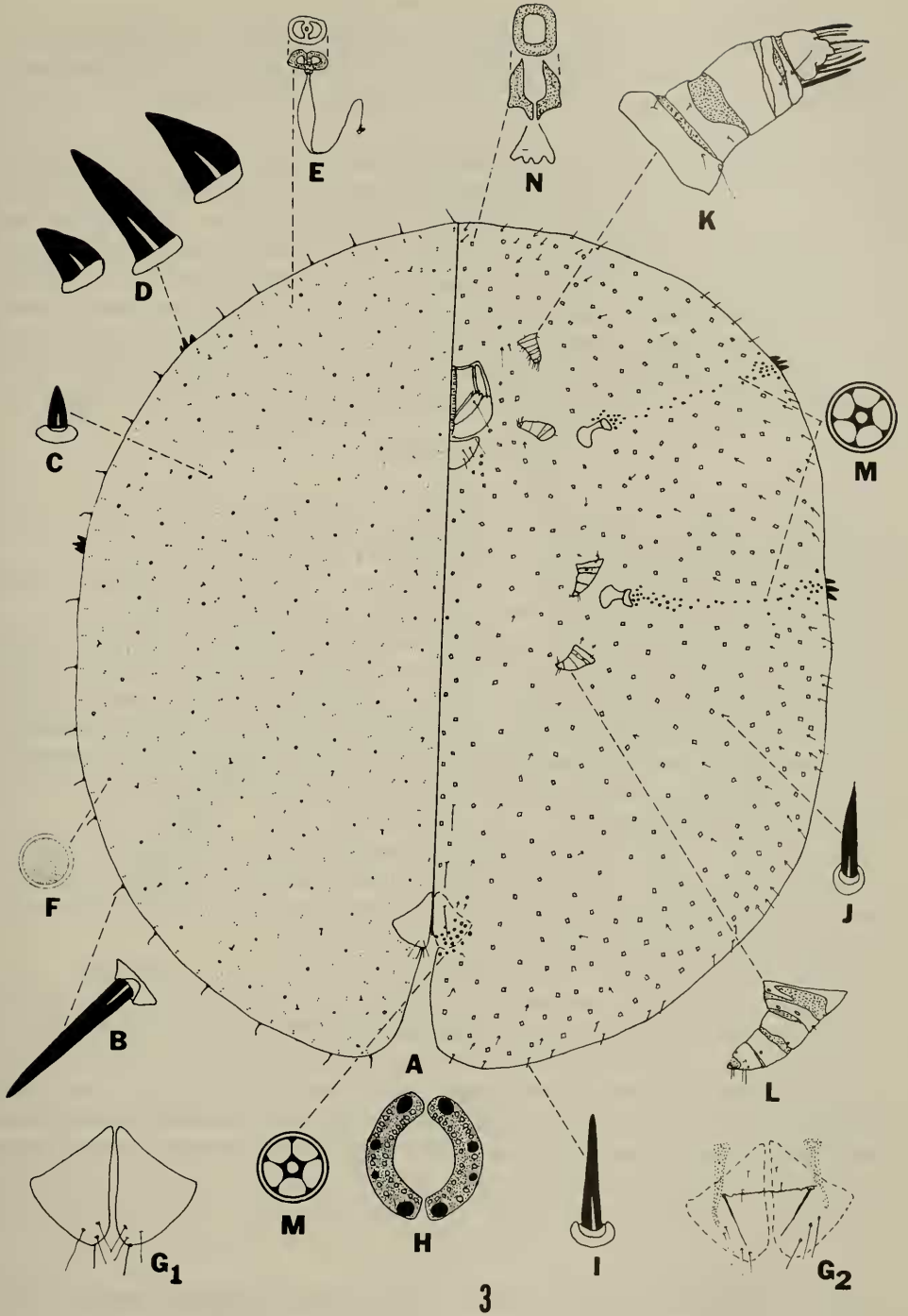


Fig. 3. *Neolecanium cornuparvum*, third-instar female.

SECOND-INSTAR MALE

Material studied.—28 (AU), 3 (USNM): *Magnolia acuminata*, Centre Co., Pa.; Great Belt, Pa. *Magnolia stellata*, Blacksburg, Va. *Magnolia* sp., Western Port, Md.; Jackson City, Miss.; Painesville, Ohio; Bedford, Pa.; Bethlehem, Pa.; Corapolis, Pa.; Pittsburgh, Pa.

The second-instar male is similar to the second-instar female (Fig. 2), but the male has dorsal tubular ducts, marginally around the cephalic $\frac{3}{4}$ of the body, a transverse row connecting the posterior ends of the marginal row, and 2 submedian rows extending from the posterior transverse row to above the position of the mouthparts from where they extend diagonally to join the marginal series. Additionally, the body shape of the second-instar male is elongate oval while that of the second-instar female is oval to nearly circular. Second-instar males are longer (1343–2413) and narrower (780–1188) than second-instar females. Other characteristics shown in Fig. 2 are also found in the second-instar male (not figured).

PREPUPAL MALE

Fig. 4

Material studied.—6 (AU), 3 (USNM): *Magnolia* sp., Jackson City, Miss.; Painesville, Ohio; Beaver Falls, Pa.; Bethlehem, Pa.; Pittsburgh, Pa.

General appearance.—Enclosed within a glassy wax test, body (Fig. 4A) membranous. Slide-mounted specimens 1894–1986 long, 736–953 wide.

Dorsum and pleural surface.—Derm membranous. Apex of head with 1 pair of marginal setae. Head with 2 pairs of short, stubby, blunt setae (Fig. 4B); 1 pair of these setae on mesothorax and 5 pairs on abdomen. Pleural abdominal setae (Fig. 4C) on segments II through VII, longest about 38 (33–43) long; becoming larger and more numerous posteriorly. Spiracular setae, submarginal tubercles, eyes, pores, and ducts absent. Wing buds 303 (253–331) long, 177 (175–178) wide on lateral margins of thorax.

Anal plates.—Replaced by 2 quadrate, sclerotized lobes, 57 (49–67) long, 54 (46–65) wide at base. Each lobe with 1 to 3 setae. Anal ring absent. Anal opening near base of well-sclerotized penial sheath; penial sheath with 0 to 4 setae; genital opening near apex of penial sheath.

Venter.—Two bristle-like submarginal setae near apex of head. Four short bristle-like setae between antennal bases. One to 4 short spinelike setae (Fig. 4D) at base of each coxa. Ventral abdominal setae (Fig. 4E) on segments III through VII bristle-like. Antenna elongate, largely membranous, 360 (324–410) long. Legs largely membranous, with poorly defined segments, 320 (242–388) long. Setae and digitules on legs reduced to peglike stubs or sockets. Spiracles with thickened apodeme and areolate base. Each spiracle with 8 to 11 pores (Fig. 4F) near atrium; pores with 4 to 8 locules. Ducts absent.

PUPAL MALE

Fig. 5

Material studied.—27 (AU), 2 (USNM): *Magnolia acuminata*, Great Belt, Pa.; Mercer, Pa. *Magnolia* sp., Western Port, Md.; Painesville, Ohio; Bethlehem, Pa.; Pittsburgh, Pa.; Scottsdale, Pa.; Charleston, W. Va.

General appearance.—Enclosed within a glassy wax test, body (Fig. 5A) membranous. Slide-mounted specimens 1634–2184 long, 606–693 wide.

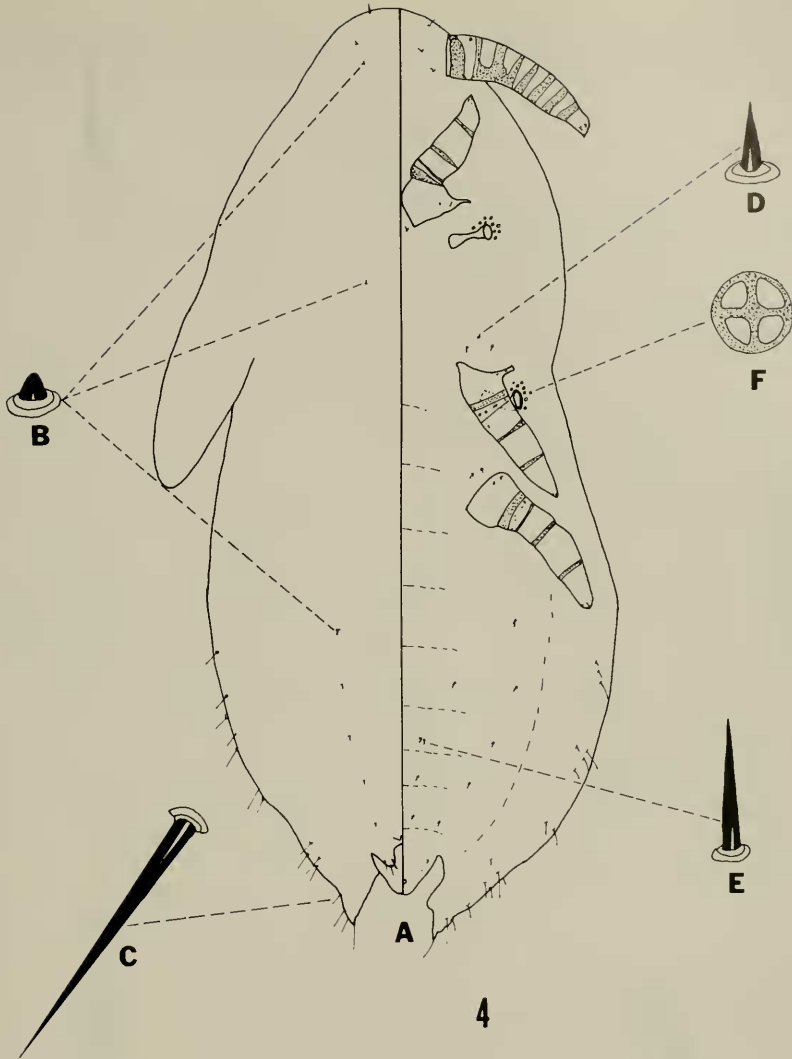


Fig. 4. *Neolecanium cornuparvum*, prepupal male.

Dorsum and pleural surface.—Derm membranous. Apex of head with 1 pair of marginal setae. Head with 3 pairs of bristle-like setae (Fig. 5B); 1 pair of these on mesothorax, and 6 pairs on abdomen. Pleural abdominal setae (Fig. 5C) on segments II through VII, longest about 47 (35–54) long, becoming larger and more numerous posteriorly. Spiracular setae, submarginal tubercles, eyes, pores, and ducts absent. Wing buds on lateral margins of thorax, 474 (439–526) long, 230 (192–266) wide.

Anal plates.—Replaced by 2 quadrate, sclerotized lobes, 63 (57–68) long, 58 (41–84) wide at base. Each lobe with 1 to 4 setae. Anal ring absent. Anal opening near base of large, well-sclerotized penial sheath; penial sheath with 2 pairs of dorsal setae; genital opening near apex of penial sheath.

Venter.—Two bristle-like submarginal setae near apex of head. Four short

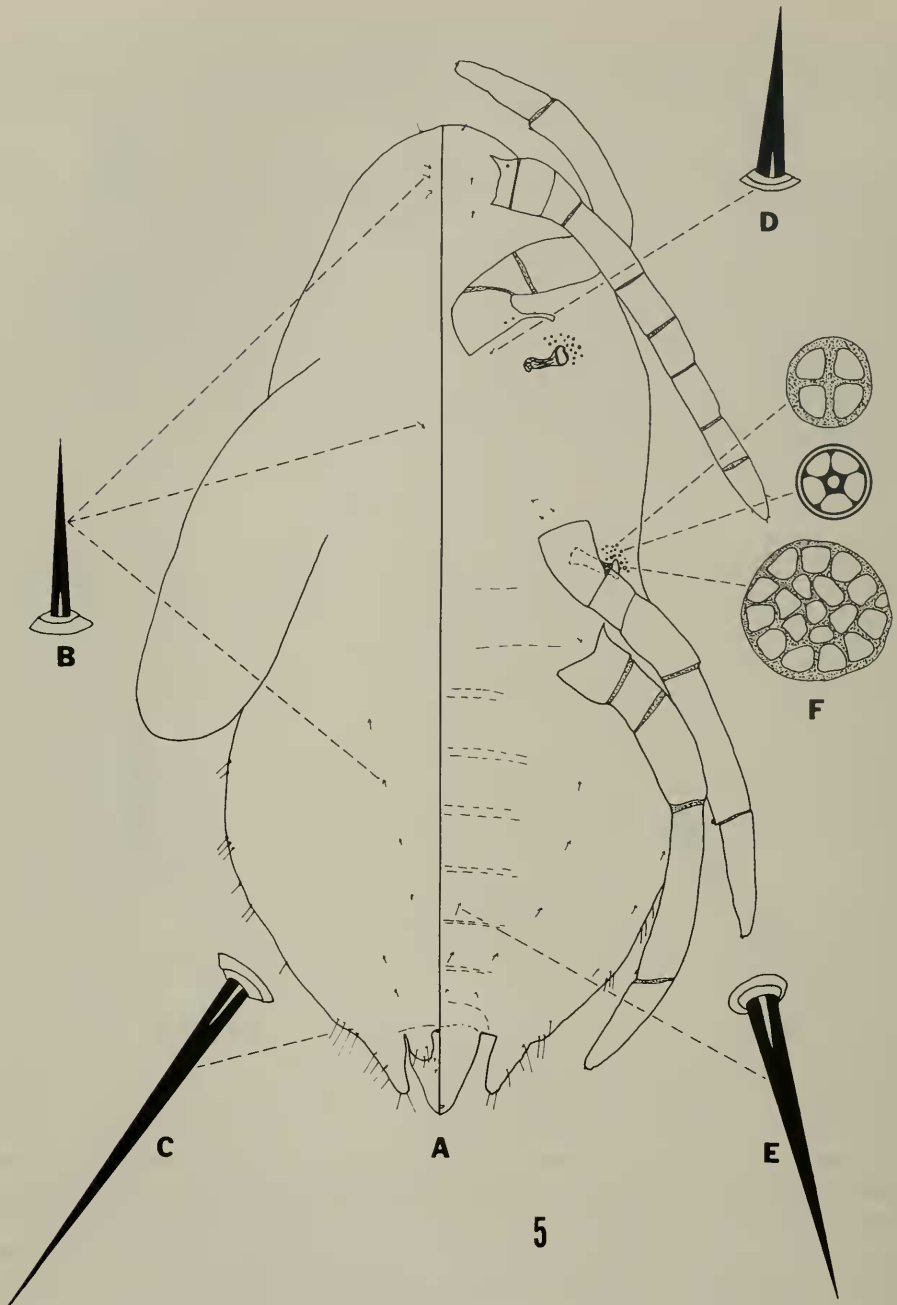


Fig. 5. *Neolecanium cornuparvum*, pupal male.

bristle-like setae between antennal bases. One to 4 short spinelike setae (Fig. 5D) at base of each coxa. Ventral abdominal setae (Fig. 5E) on segments III through VIII, bristle-like. Antenna elongate, largely membranous, 8- or 9-segmented, 786 (721-867) long. Legs largely membranous, with poorly defined segments, 829

(711–998) long. Setae and digitules on legs reduced to peglike stubs or sockets. Spiracles with thickened apodeme and areolate base. Each spiracle with 8 to 19 pores (Fig. 5F) near atrium; pores with as many as 20 locules. Ducts absent.

ADULT MALE

Fig. 6

Material studied.—16 (AU), 4 (USNM): *Magnolia acuminata*, Mercer, Pa. *Magnolia* sp., Western Port, Md.; Rochester, N.Y.; Painesville, Ohio; Bethlehem, Pa.; Coraopolis, Pa.; Pittsburgh, Pa.; Scottsdale, Pa.

General appearance.—Moderately long and robust, with relatively long antennae and long slender legs. Slide-mounted specimens 1640–2005 long, 569–712 wide at mesothorax, wing spread 3626–4059.

Head.—Median crest (mc) sclerotized, polygonally reticulate; with 19–35 hairlike and 11–20 fleshy dorsal head setae (dhs). Midcranial ridge (mcr) ventrally well developed, extending posteriorly to ocular sclerite. Gena (g) large, with cells of polygonal reticulation larger than elsewhere on body; with 10–29 hairlike and 44–73 fleshy genal setae (gs). Two subequal pairs of eyes; corneae of dorsal eyes (dse) 64 (58–74) in diameter; those of ventral eyes (vse) 57 (52–65) in diameter. Ocellus (o) 28 (23–32) in diameter. Ocular sclerite (ocs) well-sclerotized. Preocular ridge (procr) short. Postocular ridge (pocr) undivided. Interocular ridge absent. Dorsal ocular setae (dos) with 0–1 hairlike and 1–6 fleshy setae. Nine to 15 hairlike and 61–91 fleshy ventral head setae (vhs). Preoral ridge (pror) present. Tendon-like apodeme (t) present. Cranial apophysis long and bifurcate. Tentorium well developed, posterior tentorial arms well developed. Mouth opening irregular. Anterior tentorial pits (atp) present. Antenna filiform, 9-segmented, 1235 (1184–1301) long, ratio of antennal length : total body length about 1.00:1.54 (1.00:1.52–1.00:1.56); pedicel with dorsal, polygonal reticulation; apical segment with 3 capitate subapical setae (sas); segments II through IX with numerous fleshy setae, 0–1 bristle-like setae, and 0–2 sensilla basiconica.

Thorax.—Prothorax with pronotal ridge (prnr) lacking medial weakening. Lateral pronotal sclerites reduced, almost absent. One pair of medial pronotal setae (mpns) posterior to dorsomedial portion of pronotal ridge. Pleural structures typical of Coccidae. Sternum (stn1) with strong transverse ridge and median ridge represented by a basal stalk. Usually 2–6 anteprosternal setae (astn1s) present. Prosternal setae (stn1s) numerous, 1–5 anterior to mesothoracic spiracles and in a continuous band with postmesospiracular setae.

Mesothorax with prescutum (prsc) laterally bounded by prescutal ridges (pscr) and posteriorly by prescutal suture (pscs); with polygonal reticulation. Scutum (sct) with transverse, median membranous area with 15–29 hairlike and 5–11 fleshy setae. Scutellum (scl) without setae. Postnotum (pn2) with anterior margin occasionally overlapped by metathoracic fold; postnotal apophysis (pna) and postalare (pa) well developed. Basalare fused with pleural wing process (pwp). Subalare small. Episternum (eps2) with weak reticulation; subepisternal ridge (ser) well developed. Epimeron (epm2) small. Lateropleurite (lpl) bounded anteriorly by extension from marginal ridge (mr). Basisternum (stn2) large, with heavily sclerotized median ridge (mdr), bounded by heavily sclerotized marginal (mr) and precoxal (pcr2) ridges. Furca (f) well developed. Postmesospiracular setae continuous with prosternal setae. Tegula (teg) well developed with 4–9 hairlike setae.

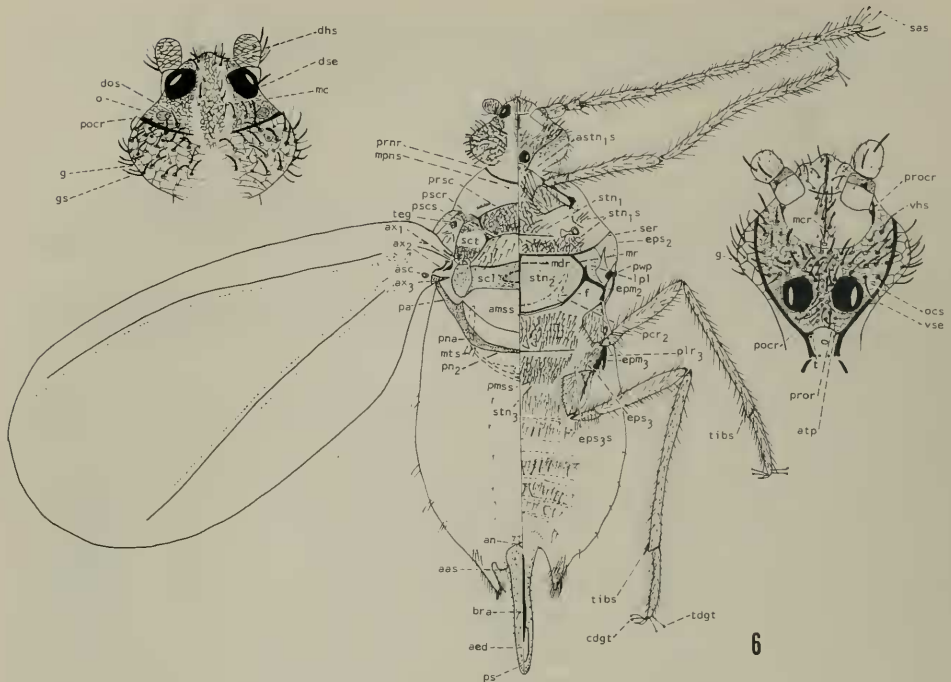


Fig. 6. *Neolecanium cornuparvum*, adult male (see text for explanation of abbreviations).

Axillary wing sclerites (ax1, ax2, ax3) typical of male Coccidae. Additional sclerite (asc) present. Antemetaspiracular setae absent.

Metathorax with suspensory sclerites absent. Postnotum unsclerotized. Metatergal setae (mts) present. Pleural ridge (plr3) well sclerotized. Episternum (eps3) lightly sclerotized; epimeron (epm3) extended posteriorly. Dorsospiracular setae absent. Postmetaspiracular setae (eps3s) numerous. Metasternal plate (stn3) lightly sclerotized. Anterior metasternal setae (amss) and posterior metasternal setae (pms) numerous.

Wings hyaline; 1618 (1423–1776) long, 758 (625–897) wide. Alar lobe and alar setae absent. Hamulohalter absent.

Legs long and slender; prothoracic 1275 (1054–1431) long; mesothoracic 1270 (1178–1359) long; metathoracic 1503 (1361–1610) long. Each tibia with an apical spur (tibs) and a few smaller spurs near apex. Each tarsus with 2 subequal digitules (tdgt). Claws with small denticle and 2 knobbed subequal digitules (cdgt).

Abdomen.—Segments I through VII with lightly sclerotized or membranous tergites; sternites represented by lightly sclerotized plates on segments II through VII. Caudal extension of segment VII long, sclerotized, with numerous setae on ventral and lateral aspects. Fleshy dorsal setae absent; 2 hairlike setae on segments II through VII. Pleural setae all hairlike, 1–6 on each segment. Two to 25 hairlike and 4–29 fleshy ventral setae on segments II through VII. Segment VIII with transverse tergite and sternite; without caudal extension or glandular pouch. Two dorsolateral lobes analogous with the anal plates representing segment IX; each with 0–4 hairlike antenanal setae (aas).

Genital segment.—Penial sheath (ps) 458 (433–489) long, 118 (104–130) wide

at base; about $\frac{1}{4}$ total body length, ratio 1 : 4.01; lateral sclerotization may or may not be jointed anterior to anus (an). Small setae scattered over sheath; cluster of sensilla occur ventrally near apex of sheath. Relative length of basal rod (bra) much greater than length of aedeagus (aed).

DISCUSSION

The adult male of *N. cornuparvum* is most similar to the *Coccus* group of Giliomee. Of the 34 characters Giliomee listed which separate the major groups of Coccidae which he recognized, *N. cornuparvum* shares 29 character states with the *Coccus* group. Five of these 34 characters have unique character states in the *Coccus* group (exclusive characters of Giliomee). *Neolecanium cornuparvum* shares only three of these "exclusive characters" with the *Coccus* group. Adult males of *N. cornuparvum*, *Pseudophilippia quantancii* Cockerell, and *Toumeyella parvicornis* (Cockerell) (none of which were studied by Giliomee) are unique among males studied in four characters: antennae with 9 segments, pronotal ridge complete dorsally, absence of a glandular pouch, and the presence of 2 lobes analogous to anal plates representing abdominal segment 9 dorsally. As the major groups of Giliomee all have 3–5 "exclusive" or unique character states, we propose that *N. cornuparvum*, *P. quantancii*, and *T. parvicornis* represent an additional major group of genera, the *Toumeyella* group.

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